Psychological Monographs

General and Applied

No. 446
1957

Louis L. McQuitty

Vol. 71
No. 17

A Pattern Analysis of Descriptions of "Best" and "Poorest" Mechanics Compared with Factor-Analytic Results

By

Louis L. McQuitty

Michigan State University

Price $1.00

Edited by Herbert S. Conrad

Published by The American Psychological Association, Inc.

Psychological Monographs: General and Applied

Combining the *Applied Psychology Monographs* and the *Archives of Psychology* with the *Psychological Monographs*

HERBERT S. CONRAD, Editor
Department of Health, Education, and Welfare
Office of Education
Washington 25, D.C.

MANUSCRIPTS should be sent to the Editor.

Because of lack of space, the *Psychological Monographs* can print only the original or advanced contribution of the author. *Background and bibliographic materials must, in general, be totally excluded* or kept to an irreducible minimum. Statistical tables should be used to present only the most important of the statistical data or evidence.

Preparation of manuscripts for publication as monographs should follow the procedures given in the APA *Publication Manual,* 1957 Revision—this revision supersedes all previous manuals for preparing manuscripts for publication as monographs.

CORRESPONDENCE CONCERNING BUSINESS MATTERS (such as subscriptions and sales, change of address, etc.) should be addressed to the American Psychological Association, Inc., 1333 Sixteenth St. N.W., Washington 6, D.C. Address changes must arrive by the 10th of the month to take effect the following month. Undelivered copies resulting from address changes will not be replaced; subscribers should notify the post office that they will guarantee third-class forwarding postage.

Vol. 71, No. 17 Whole No. 446, 1957

Psychological Monographs: General and Applied

A Pattern Analysis of Descriptions of "Best" and "Poorest" Mechanics Compared with Factor-Analytic Results[1]

Louis L. McQuitty[2]

Michigan State University

The particular method of pattern analysis developed in this paper is called *agreement analysis*. It can be introduced by contrasting it with factor analysis. These two methods differ in terms of the assumptions they imply concerning the interrelationships in subject matter they are designed to analyze. Agreement analysis is based on a generalized theory of types. The types are assumed to reflect themselves in many kinds of interrelationships among characteristics—not just linear ones. Consequently, agreement analysis is a tool for determining all of the various ways in which characteristics are presumed to concatenate to yield types. Having this general ability to isolate types in terms of all kinds of interrelationships, it is, of course, capable of isolating them in terms of any restricted kind of interrelationships among characteristics.

Factor analysis, on the other hand, assumes that characteristics concatenate in terms of linear interrelationships only. It is a tool for analyzing the linear interrelationships among characteristics and for expressing these in terms of factors. Types which may be discovered are limited either to standings on single factors or configurations of standings on several factors.

A more detailed contrast between factor analysis and agreement analysis will help give additional meaning to the latter approach. The most common method of factor analysis (R-technique) has as its purpose to take the intercorrelations between a large number of indexes of personality and analyze these to yield a few fundamental personality traits in terms of which the indexes can be classified.

An important consideration in this factor analytic procedure is that the intercorrelations are taken across all subjects of a sample; no allowance is given to the possibility that variables might be interrelated differently in various categories of subjects of a single sample. If variables are interrelated differently among categories of subjects and if the number of subjects representing each category varies considerably, then intercorrelation across all subjects as generally taken in factor analysis would represent a hodgepodge.

Agreement analysis assumes types and is a method designed to assist in their isolation; it attempts to isolate them by classifying together individuals who give identical responses to large numbers of items of a test.

Substantiation of a need for a method which contrasts with factor analysis is simple. Factor analysis does not prove the existence of factors; it merely clarifies the characteristics which they have if we postulate them.

A limiting characteristic of factor analysis is the fact that it does not include a statistic for rejecting it as not fitting data particularly well. One way to help correct for this defect is to

[1] This research was supported in part by the United States Air Force under Contract No. AF 33(038)-25726 monitored by the Commanding Officer, Air Force Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas. Permission is granted for reproduction, translation, publication, use, and disposal in whole and in part by or for the United States Government. This research was completed while the author was at the University of Illinois.

[2] Appreciation is expressed to Professor Lyle H. Lanier for both his editorial suggestions and valuable critique which were very helpful in the preparation of this paper.

develop methods based on the assumption of constructs other than factors, and compare results obtained with the two methods.

Agreement analysis postulates one kind of construct (types) which contrasts with factors. Applications of agreement analysis will help us to learn some of the characteristics which its types have. Comparisons of results from factor and agreement analyses will assist us in determining which alternative postulate is more helpful for various purposes.

This paper includes four main sections. The first sections develops the theory and method of agreement analysis and illustrates the method by applying it to descriptions of "best" and "poorest" mechanics. The second section compares the results of the agreement analysis with those of a factor analysis of common data, and interprets the types in the light of both the factor and agreement analyses. The third section critiques the method of agreement analysis. The fourth section summarizes the entire paper.

I. Classification of Descriptions by Agreement Analysis

As mentioned above, an investigation by agreement analysis is based on a theory of *types*. In the particular theory of the present investigation, the concept of type is treated as an intrinsic construct. Each type is assumed to reflect itself in a pattern of characteristics. Consequently, individuals can be classified into typological categories according to the patterns of characteristics which they exhibit. Each category into which individuals are classified is said to represent a type. The individuals of any one type are presumed to have certain characteristics in common. These characteristics are called a *pattern*. The individuals of any other type are also presumed to exhibit a pattern of characteristics, and their pattern is unique to their type. In brief, the individuals of each type exhibit a pattern of common characteristics which is peculiar to them. For example, Type X might include individuals who exhibit a pattern of dependability, carefulness, cooperativeness, and industriousness; Type Y might include individuals who exhibit the pattern of carefreeness, friendliness, joviality, and slipshodness.

The Linnaean approach (1, pp. 490–492) to the classification of living organisms in the field of biology results in a chart which shows (*a*) all types of living organisms and (*b*) the patterns of characteristics peculiar to each type. At the lowest level of classification of living things, each organism is classified into a *species*. Consequently, each species includes a number of organisms. The organisms of each species exhibit a number of common characteristics which are peculiar to them.

At the next level of classification, each species is grouped with other species to form *genera*. Consequently, each genus contains several species. The species of each genus have certain characteristics in common which are peculiar to them. In an analogous fashion, genera are grouped to form *families*, families to form *orders*, and so on through *classes*, *phyla*, and *kingdoms*.

A simplified and incomplete Linnaean chart is shown in Fig. 1 for illustrative purposes. At the bottom level of the chart, we have several individual organisms, then at the next level we have several species, then several genera, etc., up to a class. There is, of course, a pattern of characteristics for each species, genus, family, etc.

Analogously to the simplified Linnaean Chart, we propose to build a classification of certain descriptions of mechanics.

Since so little is known about the types into which descriptions of mechanics may ultimately be classified, we propose for the present to use the Linnaean terms of species, genera, families, etc., for categorizing them.

We have six purposes in building this classification; three of them are methodological, and the other three are substantive. The *methodological* purposes are (*a*) to illustrate a quantitative method for developing the classification, (*b*) to

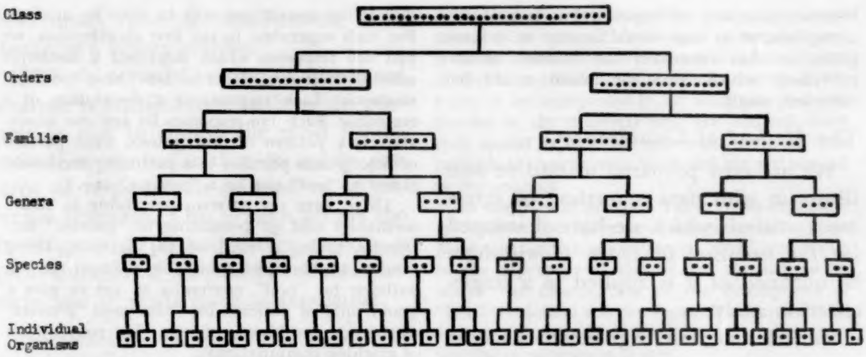

FIG. 1. A simplified and incomplete Linnaean chart.

indicate some of the potentialities of the method in the field of personnel research, and (*c*) to compare results from this pattern analytic approach with a factor analysis of common data.

The *substantive* purposes are to make a preliminary investigation of the following hypotheses: (*a*) that the descriptions of mechanics selected as "best" and "poorest" can be classified into types; (*b*) that the classifications are relatively dependable in the sense that two separate classifications of subjects on the basis of two sets of test items will yield similar results; and (*c*) that the classifications are valid in the sense that they are related to an external criterion.

The above purposes are, of course, related to a theoretical, psychological position which should be specified unless it otherwise be misunderstood. We are not attempting, initially, to isolate the types which may in some way be said to be fundamental for the generalized understanding of human behavior. For the time being, at least, it is assumed that different types may be significant for different purposes. For example, types which derive from an analysis of symptoms of diseases may be significant for differentiating between mentally and physically ill patients, but other types which derive from an analysis of characteristics of "best" and "poorest" mechanics may be required in differentiating subjects in relation to their qualifications as mechanics. We are attempting to isolate types which are significantly related to a criterion, but we are not arguing that these single criterion types are the most fundamental ones in terms of which to understand behavior in general. On the contrary, we are inclined to the point of view that behavior can be categorized in many different ways and that each way will give somewhat different types.

Even though we are interested initially in types pertinent to single criteria, we are, nevertheless, also oriented ultimately toward the more fundamental scientific problem of deriving a parsimonious, systematic structure for the inclusive representation of behavioral organization. Types which would fulfill this requirement would be minimal in number, simple in description, and of maximal value in predicting behavior.

The single-criterion studies can assist in the solution of the more fundamental problem. The types which derive from the single-criterion studies can be used as the basis for the development of those which are more generally meaningful, and therefore more basic, scientifically. Each single-criterion study will have selected a set of items, significant for the criterion under consideration. All of the items taken jointly from several single-criterion studies and analyzed simultaneously in such a manner as to isolate all the types represented in the data should produce those more comprehensive types which are pertinent to all the several single criteria. Consequently, these types should be relatively fundamental in the sense that they would be generally applicable in the prediction of behavior.

Since there is probably no absolute limit to the number of single criteria which may be used, and since each additional one may add something, it will probably always be possible to improve somewhat on the classification into fundamental types, which derive from this approach.

However, the rate of improvement is probably asymptotic, or at least would become so at some point, so that eventually the amount of improvement which could be added would become very small.

The Method of Classification

We are now prepared to outline and illustrate with data a method of agreement analysis which we have developed for the isolation of types. It will here be outlined as it is applied in a single-criterion study.

Subject and tests. Agreement analysis was applied to data which had been gathered in an earlier factor-analytic study by McQuitty, Wrigley, and Gaier (3). As pointed out in this earlier paper, an inventory of 200 items was developed using the language which mechanics used in describing other mechanics whom they had selected as representative of either "best," "poorest," or "average" mechanics. The inventory for describing mechanics was administered to 428 supervisors, who selected a "best," a "poorest," or an "average" mechanic and described him by replying either "yes" or "no" to each of the 200 items of the inventory. In the present investigation, we used the results from supervisors who described either a "best" or a "poorest" mechanic; we did not use the results from those who described an "average" mechanic.

In the first classification, we analyzed results from the first 120 items. In the second classification, we analyzed results from the remaining 80 items. The 200 items of the inventory were listed in random order. The initial classification was based on the first 120 items because the factor analysis mentioned above was in terms of these items, and we wished to compare results from the two different kinds of analyses.

We shall describe the first classification in detail; the second one will be clear by analogy. For each supervisor in the first classification, we had 120 responses which described a mechanic selected by him as either a "best" or a "poorest" mechanic. Each response is a description of a mechanic. Each 120 responses by any one supervisor is a pattern of descriptions. Each pattern of descriptions pertains to a particular mechanic, either a "best" one or a "poorest" one.

There were 112 patterns pertaining to "best" mechanics and 92 pertaining to "poorest" mechanics, giving a total of 204 patterns. Using random numbers, we arbitrarily reduced the 112 patterns for "best" mechanics to 108 to give a grand total of patterns for "best" and "poorest" mechanics, combined, of 200 (for convenience of machine computations).

Again using random numbers, we divided the 108 patterns for "best" mechanics into equal-sized experimental and cross-validational samples. We did likewise for the 92 patterns descriptive of "poorest" mechanics. The two experimental samples, one for "best" and the other for "poorest" mechanics, were used to build our classification of patterns into types. The cross-validational samples were used to determine how well the types held up on other samples of the same universe.

As the patterns of descriptions are classified, successively, into more and more inclusive types, some of the components of the patterns are dropped. In other words, the initial patterns with which we start are reduced in their numbers of descriptions as the classification proceeds into more and more inclusive types. In order to differentiate these several "levels" of classification, we shall speak of *individual patterns* when classifying the initial ones into *species;* then of *species patterns* when we are classifying into *genera;* and of *genus patterns* when we are classifying into *families;* and so on.

Details of the method. The method of analysis here used is an abbreviated version of a complete method of pattern analysis, developed by the author and called agreement analysis (6, 7). The present version differs from the complete method in these respects: (*a*) it omits a calculation which corrects agreement scores for chance fluctuations; (*b*) it applies a somewhat less exacting, but more rapid, technique for classifying patterns into the categories which they resemble most; and (*c*) it limits each category to *not more than two patterns from the*

next lower level of classification; it is therefore *a binary version.*

This abbreviated version of agreement analysis is justified here because the purpose is not to isolate the most fundamental types but rather to study patterns of responses in relation to an external criterion. This version allows the investigator to isolate rather rapidly a great number of reasonably reliable patterns and to study them as predictors.

Our abbreviated method of binary agreement analysis involves a novel treatment of the agreement score developed by Zubin (10). The agreement score is computed for pairs of individual patterns. The agreement score for any two individual patterns is *the number of identical descriptions contained in the two patterns.* Suppose that the two individual patterns A and B both contain "yes" for the first five items of the inventory, disagree on the sixth item (one pattern having a "yes" and the other pattern a "no"), and that both patterns contain "no" for the next four items. On these 10 items, the two patterns, A and B, would have an agreement score of nine, because their answers would agree on nine of the 10 items.

Each individual pattern was paired with every other individual pattern, and an agreement score was determined for each pair of individual patterns. These agreement scores are illustrated in Table 1 which shows 10 of the individual patterns descriptive of "best" mechanics. The patterns are labeled A through J and are so designated in the top row and left hand column of the table.

The number, 102, in the intersection of row A and column B of the table is the agreement score of the pair of individual patterns A and B. This same score also occurs in the intersection of row B and Column A. Other entries in Table 1 are to be interpreted in an analogous fashion. Entries in the diagonal cells are omitted, since they would report the agreement score of each individual pattern with itself and are not needed in the analysis.

In the present analysis, Table 1 was expanded to include the agreement scores for all 54 individual patterns descriptive of "best" mechanics in the experimental sample, i.e., the sample on which the classification of the descriptions of "best" mechanics was developed. Table 1 is shown as an abbreviated illustration of this larger matrix of agreement scores.

The largest agreement score in the 54×54 matrix was selected. Of all the individual patterns represented in the matrix, the two with the largest agreement score have more answers in common than any other two. *These two patterns constitute the first species.* They and all agreement scores for either of them are withdrawn from the matrix. The pair of patterns with the highest agreement score in the reduced matrix is next selected. *This constitutes species number two.* The remaining species are selected in an analogous fashion.

In the case of a tie in agreement scores, such as between the individual patterns of pair K and L, on the one hand, with M and N, on the other, it is immaterial as to which species is withdrawn first. However, in the case of a tie such as between X and Y, on the one hand, with X and Z, on the other, it is material. In this latter kind of tie with one pattern common to two pairs, we have followed the practice of classifying X with Y rather than Z only if the next highest agreement score in which Y occurs is lower than the next highest in which Z occurs. By selecting

TABLE 1

ILLUSTRATIVE SAMPLE OF "BEST" MECHANICS' AGREEMENT SCORES BETWEEN INDIVIDUAL PATTERNS

	A	B	C	D	E	F	G	H	I	J
A		102	90	93	93	99	93	91	92	99
B	102		94	93	93	97	95	93	94	99
C	90	94		101	101	95	97	97	98	100
D	93	93	101		100	100	98	92	99	98
E	93	93	101	100		102	96	92	95	94
F	99	97	95	100	102		92	90	97	96
G	93	95	97	98	96	92		100	97	100
H	91	93	97	92	92	90	100		103	100
I	92	94	98	99	95	97	97	103		105
J	99	99	101	98	94	96	100	100	105	

NOTE.—The table is to be read as follows: The agreement score between individual patterns A and B is 102; between individual patterns A and C is 90; etc. For definition of "individual pattern" and "agreement score," see text.

Y instead of Z, the agreement score which will be used to classify Z is larger than would be the one to classify Y if we had reversed our choice. If the second highest agreement scores are also tied, reference can be made to the highest ones which are not tied. These can then be used as a basis for a decision.

We have now outlined how to classify all 54 individual patterns into species, *each species containing two members, and only two.* In those studies where there is one individual pattern left over, it is classified into an additional species containing only one case.

The classification of individual patterns into species started with a pattern of answers for each mechanic described. The pattern of answers is the endorsements on the particular inventory used to describe the mechanic. The classification into species brings together those pairs of individual patterns which are highly similar, as determined by agreement scores. We can use this same approach for classifying species into genera, provided we can obtain a pattern of answers for each species.

A species' pattern of answers is those endorsements which are common to both individual patterns of the species. Suppose, for example, that both individual patterns X and Y of a species have "yes" for item 1 and "no" for item 2. Their species pattern for the first two items would be "yes"-"no." Suppose further that individual pattern X has "yes" for item 3, while individual pattern Y has "no" for this item, and they both have "yes" for item 4. Their species pattern for the first four items would be "yes"-"no"-blank-"yes." The blank denotes the fact that the two individual patterns disagree on item 3. This item is dropped from consideration in the further classification of this species. In other species where both individual patterns have the same answer to the item, it is retained.

In the manner just described, a pattern of answers is determined for each species which contains two individual patterns. These are called species patterns. In those studies where the analysis started with an odd number of cases and ends in the last species containing but one individual pattern, the pattern of answers for this species is the same as those of the one individual pattern which the species includes.

Since we now have a pattern of answers for each species, we can use the same technique for classifying species patterns into genera as we originally used for classifying individual patterns into species. Further, we can use the same plan for determining the pattern of answers for each genus as we used for determining the pattern of answers for each species. The system is entirely repetitive at each successive level; we merely continue it for classifying species patterns into genera, genus patterns into families, etc., until the classification is completed.

In an analogous fashion as outlined above, we classified the patterns descriptive of "poorest" mechanics. This classification had to be discontinued at the class level, where there were only two classes, because the patterns for classes contained common responses to no item.

Unique features of the method. The method of analysis contains a number of unique features. It is essential to appreciate these if the implications of the method are to be understood and if results from it are to be properly interpreted. These unique features can be introduced by showing how the method is designed to capitalize on the predictive possibilities of responses treated in combinations.

Meehl (9) has illustrated that it is theoretically possible for responses treated in pairs to have relationships to a criterion even though the items treated separately have zero relationship to a criterion. This potentiality of responses treated in pairs would appear to make it highly desirable to analyze responses in combinations of two. However, 100 two-answer items taken two at a time would yield 4,950 pairs of items and 19,800 response pairs for analysis. To analyze this many combinations would be an unreasonably laborious task. Besides, to analyze in combinations of two is not an entirely satisfactory solution. For, if pairs have potentialities over and above separate items, then by the same logic triads have potentialities over and above pairs, and likewise any order of a

combination has potentialities over and above any one of lower order. We are forced then to the conclusion that it is essential to treat items of a test in relatively large combinations if we are to investigate thoroughly the predictive potentialities of the test.

To analyze all items of a test in combination is not nearly as laborious as it would at first seem. Even though there are many combinations of responses theoretically possible, only a very few of them occur empirically, and those which do not occur need not concern us.

In those patterns which do occur, some of the responses are relatively undependable and may be disregarded. A problem is to determine which responses are relatively undependable. In our approach to this problem, we assume that a response may be completely dependable for some subjects and completely undependable for other subjects.

This assignment of differential, all or none, dependability of responses *in relation to the subjects who give them* is novel in test analysis. The usual approach is to assign a single index of reliability for each item as computed from the average behavior with respect to it, even though some subjects may always give the same response to an item while others continually change in their responses.

Our approach, on the other hand, assigns a perfect reliability to an item for those subjects whose responses to it are consistent with their responses to other items. For the same item, our approach assigns a zero reliability for those subjects whose responses to this item are inconsistent with their responses to other items.

In an effort to determine which responses are consistent with other responses, we classify subjects together as already explained in our method of agreement analysis. In this approach, some items are irrelevant (undependable) in the sense that they do not classify a pattern in the same fashion as the majority of the responses in a pattern. As an illustration, suppose that a test of 100 items is administered to 100 subjects, and that subjects A and B agree in the answers which they give to 99 of the 100 items. Suppose further that the next highest agreement score that either of these subjects has with any other subject is 80. We would conclude that A and B should be classified together in terms of their patterns of responses to the items of the test, and that their responses to the one item on which they disagree is irrelevant to their classification. Their classification would be achieved in terms of their predominant patterns of responses, where these patterns are defined as the ones which include the greatest possible number of responses and still yield a classification.

Consequently, any response which does not conform to the predominant pattern of responses is presumed to be irrelevant. It is assumed to vary independently of the responses in the predominant pattern. In computing a correction for agreement scores in the complete method of analysis (6, 7), irrelevant responses are assumed to vary by chance with respect to the predominant patterns.

A response which is irrelevant in the classification of one subject may, however, be relevant in the classification of another subject. Suppose that the one item on which subjects A and B of the above example disagree is item 2; their responses to this item are irrelevant in classifying them together. Suppose further that C and D are classified together because they agree on 99 (of 100 items) including item 2 but excluding item 3. In this case item 3 rather than item 2 would be designated as irrelevant; item 2 would be relevant for subjects C and D but not for A and B.

As the classification by agreement analysis proceeds from the species levels to higher ones, the criterion for judging responses to be relevant usually becomes more stringent. In order for a response to an item to be relevant in the first classification, a response to it has only to be given by both of two subjects who classify together. As the classification proceeds, more and more individuals are classified into fewer but larger categories and all of the subjects of any one category have to agree on a response in order for it to be relevant to their classification.

Since irrelevant responses are assumed to be independent of the predominant patterns which determine the classification, they are presumed to occur by chance with respect to the predominant ones. Consequently, irrelevant responses can be expected to yield both agree-

ments and disagreements between predominant patterns. We can spot those which yield disagreements as shown above. From these, we can estimate the number of irrelevant responses which yield agreements in any classification. For example, if subjects A and B who agreed on 99 out of 100 items of a test were responding to items which have only two possible answers, we would expect that their agreement on irrelevant responses would equal their disagreement on irrelevant responses. Since they disagreed on one irrelevant item, we would estimate that they agreed by chance on one irrelevant item and we would further estimate their true agreement score to be 98 rather than 99. This example illustrates the logic on which our corrected agreement score is based for the complete version of agreement analysis (6, 7).

It is helpful to emphasize the assumption on which the correction is based in order that agreement analysis can be properly understood. The correction does not assume that each answer alternative is equally apt to occur, as many colleagues have originally thought when they first examined the method. It assumes instead that subjects are equally apt to give any one of the possible answer alternatives *to those particular items which are irrelevant for their classification into predominant patterns.*

Results from the Classification

A portion of the results from classifying descriptions of "best" mechanics is shown in Table 2; space does not permit showing all of them. In the table, the lowest level of classification represents the individual patterns; the next level represents species; and then a genus is shown. This table corresponds to only a small portion of the chart shown as our model in Fig. 1. It corresponds to any section which includes *one genus, two species,* and *four individual patterns.*

Table 2 shows certain detailed information not shown in Fig. 1. The capital letters of Table 2 are codes for patterns descriptive of "best" mechanics. Thus the entry on the left side of the table at the species level means that this species includes individual patterns K and L. Under this species is a twice underlined number, 106; this is the number of items on which individual patterns K and L agree. It is their agreement score, out of a total of 120 times. At the genus level, we find the codes K-L and H-I.

TABLE 2

AN ILLUSTRATIVE CLASSIFICATION OF DESCRIPTIONS OF "BEST" MECHANICS

Genus: K-L-H-I Agreement score: 86			
Species: K-L Agreement score: 106 "No" Ans.: 4, 8, 32 33, 40, 61, 70, 75, 89, 103 112 "Yes" Ans.: 2, 5, 26, 31, 56, 77, 80, 111, 116		Species: H-I Agreement score: 103 "No" Ans.: 5, 15, 52, 71, 80, 86, 116 "Yes" Ans.: 4, 9, 40, 49, 50, 59, 66, 87, 96, 112	
Individual Pattern: K	Individual Pattern: L	Individual Pattern: H	Individual Pattern: I
"Yes" Ans.: 9, 15, 49, 52, 71, 86, 87, 96, 100	"Yes" Ans.: 50, 55, 59, 66, 81	"Yes" Ans.: 2, 32, 33, 61, 70, 77, 100, 111	"Yes" Ans.: 8, 26, 31, 55, 56, 75, 81, 89, 103
"No" Ans.: 50, 55, 59, 66, 81	"No" Ans.: 9, 15, 49, 52, 71, 86, 87, 96, 100	"No" Ans.: 8, 26, 31, 55, 56, 75, 81, 89, 103	"No" Ans.: 2, 32, 33, 61, 70, 77, 100, 111

Capital letter = codes for patterns.

Double underlined numbers = agreement scores.

Other numbers = codes for items. The code numbers listed immediately below each of the two species, for example, represent the items for which both individual patterns of the species have the same answer, but for which at least one individual pattern of the other species has the opposite answer. In cases where both individual patterns of the other species have the opposite answer, the code numbers are underlined. Only those items are listed at each level which are dropped at the next higher classification as irrelevant. The two individual pattern of species K-L disagree on 14 items. These items are listed under both individual patterns K and L, but with opposite answers in the two places; the individual patterns of the species agree on the other 106 items of the inventory.

These letters mean that this genus includes species patterns K-L and H-I, which were derived from individual patterns K, L, H, and I. They agree on 86 items as shown by the twice underlined number, 86, listed under the code letters for the genus. Other code letters and other twice underlined numbers of Table 2 are interpreted in an analogous fashion.

The species are arranged from left to right according to the size of agreement scores, with the largest ones on the left. In other words, as we move from left to right across charts such as the one of Table 2, the classifications generally become less dependable, simply because we thus generally obtain successively smaller agreement scores, and they are successively less dependable.

In a complete chart of results (which could be prepared from the analysis), all of the items and responses to them would be listed in such a manner as to show both the exact answers contained in any pattern, and which items differentiate various individual patterns, species, genera, etc., one from another and to what extent. These points can be illustrated by reference to the incomplete chart of Table 2. Consider the items listed immediately below either of two species which classify in a genus. The items below either of these two species are the ones for which each individual pattern of the species has the same answer, and for which at least one individual pattern of the other species has the opposite answer; sometimes both individual patterns of the other species have the opposite answer. In this latter case the code numbers for the items concerned are underlined. The items are classified according to whether the agreement is in terms of a "yes" answer or a "no" answer. For example, both individual patterns of species K-L have a "yes" on the list of items beginning with 2, 5, 26, etc.; and both individual patterns of species H-I have a "no" on the list of items beginning with 5, 15, 52, etc. Items 5, 80 and 116 are common to these two groups, as indicated by the single underlines. For these two species, the latter three items are perfectly positively correlated with each other and perfectly negatively correlated with the other underlined items of the species, i.e., items for which species K-L have "no" answers and species H-I have "yes" answers.

A complete chart would show the entire description contained in each individual pattern, each species pattern, each genus pattern, etc. This can be illustrated by reference to the incomplete chart of Table 2. Suppose that we want to know the composition of individual pattern L. The answers to the items listed immediately below it give only a few of the answers which it includes; some of the others are the answers to the items listed for the species containing the letter L, namely species K-L. Still others are the answers of the items for genus K-L-H-I. These latter answers are not shown in the incomplete chart of Table 2 because of lack of space. Analogously, as would be shown on a complete chart, all of the additional answers of individual pattern L, would be listed for the family, order, class, and phyla which contain the letter L. The classification was completed at the phylum level because all classes came together in a single phylum. The description of any other initial pattern or any species, genus, family, etc., can be read in an analogous fashion from a complete chart. We see then that there is a very unusual and important feature of a complete chart. Even though it is the terminal table of a method which has analyzed data in order to facilitate interpretation of it, *no piece of information is lost; the response of each subject to each item is shown.*

The above described feature of retaining every piece of information in the summary table (derived from the analysis) is not realized without creating a problem. One purpose of scientific inquiry is to abstract that material which leads to generalizations. If all information is retained, no abstracting has occurred. However, abstracting can occur at various levels. In agreement analysis, each successive level of classification represents an increase in the degree of abstraction. Consequently, the question arises as to which level yields the most meaningful results. From a purely practical point of view, we can argue in favor of that level which yields the closest relationship with an external criterion. However, this principle would appear to be a rather tenuous one on which to base fundamental, scientific decisions. A better scientific basis can be suggested if the problem is considered in the light of the theory out of which agreement analysis developed. This theory postulated real types. If real types exist, they may be either concise and discrete or more amorphous in nature. If they are discrete, then they should reveal themselves most cogently at some one level of classification. *This would probably be the level of classification at which the agreement scores have the highest statistical significance.* Consequently, statistical theory of significance could be applied in an effort to determine the level of classification in which real types are portrayed. Some statistics designed to evaluate the significance of agreement scores have been reported elsewhere (4).

On the other hand, suppose that types exist only in a relatively amorphous sense; those at any one level are ill-defined and fade into those at the next higher level. Under these conditions, there might be no very fundamental basis for stating that the types at any one level are more basic than those at any other level. *The level of primary concern would then have to depend on*

some utilitarian consideration, such as the degree of relation to an external criterion.

There is another unusual feature of agreement analysis. Since the analysis is based on combinations of answers, and since no combination whatsoever is excluded by the method, the method automatically handles whatever kinds of interrelationships (linear, curvilinear, and disjunctive) are involved in the data, without in any way restricting them. The method also allows any specific answer to be given various meanings, or interpretations, depending on the combinations or patterns of other answers with which it occurs.

Reliability of the method. In order to investigate the reliability of the method of classifying subjects into categories, the 100 subjects of the experimental sample who were originally classified on the basis of the first 120 items of the inventory were again classified on the basis of the last 80 items of the inventory. In the original analysis, the 54 descriptions of "best" mechanics and the 46 descriptions of "poorest" ones were classified separately. This same approach was followed here in classifying the subjects on the basis of 80 items, thus resulting in two independent studies of reliability, one on descriptions of "best" mechanics and the other on descriptions of "poorest" mechanics.

Each analysis was continued until every individual was classified into one of two large categories at the top level of classification. However, we did not wish to assess reliability at this highest level exclusively, because as already pointed out we planned tentatively to study later the validity at all levels of classification and we wished to know whether or not the classification was sufficiently dependable to justify validity studies. For this latter purpose, it did not appear necessary to study reliability at all levels, if we could gain an overview from selected portions. Consequently, for the purpose of comparing the classifications on the basis of 80 items with the earlier ones on the basis of 120 items, we selected categories which were intermediate in the analysis. The categories were selected so that every subject was classified once and only once for the 80-item study, and likewise for the 120-item study. In the case of "best" mechanics, we selected for both studies the first class (two orders) of 32 subjects resulting from the analyses and the two remaining orders of 16 and 6 subjects. In the case of "poorest" mechanics, we selected the first order (two families) of 16 subjects and the four remaining families of 8, 8, 6, and 8 subjects. The categories of "best" mechanics were ordered in each analysis according to the number of test items on which the patterns of each category agreed. In the 120-item analysis of "best" mechanics, the 32-subject class agreed on 43 items, the 16-subject order on 31 items and the 6-subject order on six items. These categories were designated 1, 2, and 3 respectively. In the 80-item analysis, the 32-subject class agreed on 36 items, the 16-subject order on 24 items and the 6-subject order on 13 items. These categories were designated *a*, *b*, and *c* respectively.

To the extent that categories *a*, *b* and *c* have common members with categories 1, 2 and 3, respectively, the method of analysis is reliable across items. The correspondence between these two sets of categories is shown in Table 3. Thirty-four of the 54 cases, 63 per cent, have identical classification in the two analyses. Combining categories 3 with 2 and *b* with *c* to obtain a 2×2 table (with larger expected frequencies), we computed the chi square and found it to be 5.12, significant at about 0.02. (Chi squares of 5.41 and 3.84 are required for $p = 0.02$ and $p = 0.05$ respectively.)

TABLE 3

Association Between Two Agreement Analyses of Common Subjects ("Best" Mechanics)

Categories From Last 80 Items	Categories From First 120 Items		
	3	2	1
a	1	8	23
b	1	7	8
c	4	1	1

The analogous results for the 5 categories of the "poorest" mechanics are shown in Table 4.

TABLE 4

Association Between Two Agreement Analyses of Common Subjects ("Poorest" Mechanics)

Categories From Last 80 Items	Categories From First 120 Items				
	8	7	6	5	4
d					8
e			1	4	3
f	5		5	2	4
g	1	5			
h	2	1	2	2	1

Twenty-four of the 46 cases, 52 per cent, have identical classifications in the two analyses of "poorest" mechanics. Combining categories 8, 7, and 6; 5 with 4; *f*, *g*, and *h*; and *d* with *e* to obtain a 2×2 table (with larger expected frequencies) we computed the chi square and found it to be 16.81, significant at better than 0.001. (The chi square for $p = 0.001$ is 10.83.) These two sets of results show that *binary agreement analysis gives reasonably dependable results even when applied to relatively homogeneous groups such as "best" or "poorest" mechanics.*

Validity of the method. The two classification schemata from the original analysis based on 120 items (one for patterns descriptive of 54 "best" and the other for patterns descriptive of 46 "poorest" mechanics) were investigated as tools for differentiating between cross-validational samples. In order to simplify a discussion of the method used, suppose we have an individual pattern X, which is not one of the experimental patterns, and suppose its categorization as between "best" and "poorest" is kept a secret until we classify it in terms of the two schemata. We then check to see if the classification is correct. In order to classify pattern X in terms of the two schemata, we first obtain an agreement score for it with *each* of the individual patterns of the experimental samples. On the basis of these agreement scores, we classify individual pattern X in one of three ways, namely, (*a*) as a pattern descriptive of a "best" mechanic, if its highest agreement score is with an experimental "best" individual pattern, (*b*) as a pattern descriptive of a "poorest" mechanic, if its highest score is with an experimental "poorest" individual pattern, or (*c*) as indeterminate, if there is a tie and individual pattern X has its highest agreement score with both a "best" and a "poorest" experimental, individual pattern. The classification schemata are valid for individual pattern X if they classify it correctly.

However, in the above procedure, we have not yet exhausted all of the potentialities of the classification schemata. In fact, we have hardly used the schemata at all. We have scored individual pattern X in terms of individual patterns only. We can also score it in terms of the patterns of species, genera, families, etc., for "best" and "poorest" experimental data and classify it as either "best" or "poorest" at each of these levels. A problem is to discover which level gives results in closest agreement with the criterion classification. This problem is investigated by classifying many cross-validational, individual patterns as "best" or "poorest" at each level and analyzing the results to determine which level gives the highest percentage of correct classifications. We did this for the individual patterns of our cross-validational samples.

The results are shown in Table 5, which reports the percentages of correct classifications for cross-validational, individual patterns descriptive of "best" and "poorest" mechanics, shown separately, and then also combined, with each category weighted equally. For example, at the species level, 100 per cent of the individual patterns for "best"

TABLE 5

PERCENTAGES OF CORRECT CLASSIFICATION ON THE CROSS-VALIDATION SAMPLE (120 ITEMS)

Classification	Individuals	Species	Genera	Families	Orders	Classes	Phyla
"Best"	96	100	100	100	100	100	100
"Poorest"	89	83	76	70	70	33	13
Combined	93	92	88	85	85	67	57

mechanics and 83 per cent of those for "poorest" mechanics were correctly classified. A mean of these two, namely 92, is the average percentage of the combined groups correctly classified. The maximum percentage of correct classifications for the individual patterns descriptive of "poorest" mechanics is 89 and occurs at the individual level. For those descriptive of "best" mechanics, it is 100, for all levels above that of the individual patterns. For "best" and "poorest" combined, and equally weighted as groups, the maximum percentage of correct classifications is 93 and occurs at the individual pattern level.

Multiple types of "best" and "poorest" descriptions. There is one very interesting characteristic of the cross-validational percentages. The largest percentage for the individual patterns descriptive of "poorest" mechanics is at the *individual-pattern* level, with 89 per cent correctly classified; the percentages then show a decrease down to only 33 per cent correctly classified at the *class* level. In other words, as descriptions of both "best" and "poorest" mechanics are classified separately into more inclusive categories, the items in terms of which the "best" and "poorest" descriptions differ drop out of the analysis. These items which differentiate as between "best" and "poorest" descriptions also differentiate within both the "best" and "poorest" groups and consequently yield many types of both "best" and "poorest" descriptions. On the other hand, the items in terms of which many "best" descriptions agree have identical or similar responses for descriptions of "poorest" mechanics; "poorest" descriptions do not differ from "best" ones primarily in those characteristics which are common to "best" descriptions, but rather in those which are relatively heterogenous for even "best" descriptions. Our analysis revealed no *single* ideal type of "best" mechanic which differs from an all-inclusive prototype of "poorest" mechanic; *multi-types* seem to be required if maximum differentiation is to be obtained between categories of "best" and "poorest" mechanics.

Hypotheses analogous to the ones just outlined have derived from a similar study by the writer which compared mental hospital patients with community subjects (5). Mental hospital patients do not seem to differ from community subjects on those characteristics which are common to almost all community subjects. Instead, they appear to differ more on those characteristics which are peculiar to species and genera of community subjects. Multi-types of both patients and community subjects appear to be required in order to achieve maximum differentiation. These hypotheses might prove helpful in areas which have frustrated quantitative efforts to differentiate categories of individuals satisfactorily.

Improvement through item selection. The fact that the percentage of correct classifications decreases as we move from species to higher level categories suggests the hypothesis that items which are relevant to the greatest number of species are the most effective in obtaining correct classifications. However, some items are relevant for both species and higher-level categories. In fact, in order to be relevant for a higher-level category, an item must be relevant for all species classified in it. But items which are relevant at both species and higher levels would fail to yield the species. In order to differentiate between species, we must have some items which are relevant *at the species level only.* In attempting to select a reduced number of items which would be equally as effective as the original 120 items, we selected 26 items with the following characteristics: (*a*) each item selected must be relevant for at least 82 per cent of the species isolated; (*b*) some of the items selected

must be relevant primarily at the species level only; (*c*) others must be relevant at higher levels as well. As a consequence, the items selected varied in relevancy at the order level from those which were relevant for only 16 per cent of the orders up to those which were relevant for 71 per cent of the orders.

Using these 26 items, in lieu of the original 120 items, we repeated both the experimental and cross-validational studies. As a control group of items against which to compare the above selected sample, we chose 26 items *at random* from the 120 original ones and also repeated the studies on them.

The percentages of correct classifications derived from 26 *especially selected* items on the cross-validational samples is shown in Table 6. It is analogous to

TABLE 6

PERCENTAGES OF CORRECT CLASSIFICATIONS FOR CROSS-VALIDATION SAMPLES (26 ITEMS OF KNOWN RELEVANCIES)

Classification	Individual	Species	Genera	Families	Orders	Classes
"Best"	98	100	100	100	100	100
"Poorest"	89	89	85	72	63	20
Combined	94	95	93	86	82	60

Table 5, which was based upon 120 items. For combined samples ("best" and "poorest") of the cross-validational subjects, the 26 items give higher percentages of correct classification than the 120 items at the individual, species, genus, and family levels; at the order and class levels, the 120 items give the higher percentages. The highest percentage of correct classifications, namely 95, is obtained at the species level for the 26 items.

The percentage of correct classification derived from the 26 *randomly selected* items for the cross-validational subjects are shown in Table 7. This table is anal-

TABLE 7

PERCENTAGES OF CORRECT CLASSIFICATION, FOR CROSS-VALIDATION SAMPLES, 26 RANDOM ITEMS

Classification	Individual	Species	Genera	Families	Orders	Classes
"Best"	100	100	100	100	100	100
"Poorest"	78	76	78	76	72	48
Combined	89	88	89	88	86	74

ogous to Table 5, based upon the 120-item study, and to Table 6, based upon the 26 especially selected items.

The 26 especially selected items gave the two highest percentages of correct classification, 94 and 95, and tied with the 120 items for the third highest, 93. In addition to this tie, the 120-item test gave the fourth highest percentage, 92. The 26 random items gave the fifth highest, 90, and tied with the 120-item test on the sixth highest, 88.

Since the purpose of selecting items was to obtain those most effective at the species level, we computed the significance of the difference in percentage of correct classifications at this level between the 26 especially selected items and the 26 items chosen at random. Table 8 shows the

TABLE 8

ACCURACY OF CLASSIFYING SUBJECTS WITH RANDOM VS. SELECTED ITEMS

26 Random Items	26 Items of Known Relevancies	
	Incorrect	Correct
Correct	0	88
Incorrect	5	7

data for this computation, assuming a correlation between the percentages. However, this table does not meet the minimal requirements for a computation of this kind; one cell has a zero entry and the cell diagonally below it has only seven as an entry (2, p. 80). A test which fails to assume a correlation can, however, be applied to this data provided the result is interpreted with the understanding that it is an underestimate of the significance of the difference to the extent that the percentages are correlated, as they would normally be in a situation of this kind. A test of this kind (2, p. 76) was applied. It produced

a critical ratio of 1.88, which is significant at the 0.03 level in a single-tail interpretation, as is here appropriate.

The empirical results reported above support the hypothesis that items which have high relevancies for species and vary in their relevancies for higher-level types give higher percentages of correct classifications than an equal number of randomly selected items.

In cases where an agreement analysis fails to give a satisfactory percentage of correct classifications, there is sometimes a possibility of improving on the results. This possibility derives from the fact that one application of agreement analysis to all of the items of a test isolates only the predominant types. The responses which do not fit these types are rejected at the various levels of classification. The pattern analysis could be repeated on the rejected responses. These would yield species not isolated from the analysis of the test as a whole. They might give correct classification missed by the other items. In the present study, we had relatively few incorrect classifications and relatively few responses rejected at the species level. As a consequence, we did not try a reclassification on the basis of rejected items;

TABLE 9

43 ITEMS DESCRIPTIVE OF THE FIRST CLASS (2 ORDERS) OF "BEST" MECHANICS ($N=32$)

Item No.	Response	Item
1	Y	He can get along with people pretty well.
11	Y	When he does a job, you know it will be done right.
13	Y	He answers questions as best he can.
17	Y	He knows how to use tools.
18	Y	His personal traits are O.K.
39	Y	You can take his word for what he says he's done.
44	Y	He deserves a promotion.
47	Y	You don't have to worry about telling him what to do all the time.
57	Y	He sees decision through to an end.
60	Y	He uses the right tools when he can get them.
67	Y	He is very glad to help somebody else.
68	Y	He makes sure he does a good job.
72	Y	He tries to find better ways of doing things.
73	Y	His work is nearly 100% correct.
78	Y	The pilots all seem to get along with him pretty well.
85	Y	What he doesn't know he can find out for you one way or another.
90	Y	Everyone enjoys working with him.
91	Y	He knows his stuff.
97	Y	If you leave him to do a job, you can always be sure he will get the job done.
98	Y	What he knows, he never forgets.
101	Y	He usually remembers things which are explained to him.
105	Y	He can show you how to do the job right.
106	Y	His ambition will pay off.
107	Y	He is good at working on the plane.
118	Y	He gives good cooperation.
119	Y	He seems to take pride in his work.
7	N	He is more often wrong than right in his decisions.
10	N	He works in a sloppy way.
21	N	He is afraid to make a decision one way or the other.
27	N	Most guys with that much experience know a lot more than he does.
28	N	He just stands around until you're done before offering to help.
30	N	He doesn't have any sense of responsibility.
35	N	He's just careless.
38	N	He isn't a very careful worker.
41	N	He achieves his aim in the wrong way.
46	N	He's always getting messed up in money deals.
69	N	He is kind of slipshod in his ways.
74	N	When he does get over to work, he doesn't do a thing.
93	N	You have to explain every little step to him.
95	N	No cooperation at all.
113	N	Sometimes you can trust him and sometimes you can't.
115	N	Instead of doing it, he says, "I'll think about it."
120	N	He "goofs-off" all day long.

a reclassification on the basis of the present data would not represent a critical evaluation of the proposal, and it is too laborious to apply it to noncrucial data just because the latter are available.[3]

In the results of the several analyses reported herein, it is helpful to mention that all of them agree in differentiating more "poorest" descriptions from "best" ones at the lower levels of classification, where there are relatively many categories and each one classifies only a few individual patterns, rather than at the higher levels, where there are few categories and each classifies a large number of individual patterns under it.

II. A Joint Consideration of Agreement and Factor-Analytic Results

In this section types are interpreted in terms of results from both agreement and factor analyses. Then, the interassociations between factors and types are studied further in terms of items which are common and distinct for the types and factors.

Interpretation of the Types

Several of the primary advantages of agreement analysis are realized when we attempt to interpret the types. Each type is broad in the kinds of information furnished about the subjects who constitute the type, provided the test is wide in its coverage. This point is illustrated by listing the characteristics which were found in this study to belong to the first class (32 subjects) of "best" mechanics isolated. These characteristics are shown in Table 9, with the items which were answered "Yes" listed first, and those answered "No" following.

The diversity of characteristics represented by these descriptions is illustrated by considering several of the items at the beginning of the above list. The first one tells about human relationships, the next one about quality of job performance, the next about reactions to questions, then about use of tools, personal traits, truthfulness, etc., in the order named, with each one giving information in a different area of behavior.

The diversity of information furnished about each type is further substantiated by a brief comparison of results from the agreement analyses with those from a square root, unrotated factor analysis of common data.

The 120 items which were analyzed here by two separate agreement analyses, using first 54 "best" mechanics and then 46 "poorest" ones, previously had been factor analyzed using 428 subjects (3), including those used in the agreement analyses. Using the results of this factor analysis, we examined the 43 items listed above as descriptive of the first class of "best" mechanics. These 43 items represent substantial loadings on 13 of the 23 factors reported in the factor analysis. Each of these 13 factors contains at least two items from the above 43 with loadings in its upper ten, and nine of the 13 factors contain four or more items (from the 43) with loadings in the top ten per factor. The first factor has all of its 10 highest loaded items represented in the 43 descriptions of the first class of "best" mechanics. The next two factors have none represented; the fourth has eight in the top ten. The others are as follows, with the factor number listed first, followed by the number of items from the first class with loadings in the top ten:[4] 5-4, 6-5, 7-0, 8-5, 9-6, 10-0, 11-1, 12-5, 13-1, 14-7, 15-1, 16-5, 17-2, 18-2, 19-2, 20-0, 21-1, 22-1, 23-2. This comparison shows that the first class covers a wide breadth of information in terms of the number of factors involved.

Similar data for the last order of "best" mechanics (6 subjects) described in terms of 20 items, shows the following numbers of items

[3] In addition, we have recently developed a method of multiple classification by agreement analysis whereby a subject can be classified in terms of all of the category patterns which are contained in his individual pattern.

[4] Five of the factors had fewer than ten items listed because a lower limit for loadings of .100 was applied. These five factors had 9, 9, 6, 7, and 4 items respectively. Our comparison was restricted to the items listed.

TABLE 10

20 ITEMS DESCRIPTIVE OF THE FOURTH ORDER OF "BEST" MECHANICS ($N=6$)

Item No.	Response	Item
1	Y	He can get along with people pretty well.
14	Y	He has a nice appearance.
17	Y	He knows how to use tools.
36	Y	When he works, he really works.
68	Y	He makes sure he does a good job.
94	Y	He's just a "regular Joe."
97	Y	If you leave him to do a job, you can always be sure he will get the job done.
99	Y	He's just a normal guy.
107	Y	He is good at working on the plane.
119	Y	He seems to take pride in his work.
30	N	He doesn't have any sense of responsibility.
33	N	He thinks he has had a raw deal in the service.
35	N	He's just careless.
41	N	He achieves his aim in the wrong way.
53	N	You have to stand over him and show him how to do everything.
81	N	He shines in making decisions.
89	N	He occasionally drinks as he works.
95	N	No cooperation at all.
104	N	He isn't a credit to the Air Force.
120	N	He "goofs-off" all day long.

with relatively high loading on the factors, with the factors listed first, followed by the number of items: 1-3, 2-0, 3-1, 4-7, 5-1, 6-1, 7-1, 8-5, 9-2, 10-0, 11-0, 12-2, 13-1, 14-2, 15-1, 16-1, 17-1, 18-2, 19-2, 20-0, 21-0, 22-2, 23-1. Analogous data for the third family of "poorest" mechanics (8 subjects described in terms of 28 items), is as follows: 1-4, 2-4, 3-8, 4-0, 5-0, 6-6, 7-2, 8-0, 9-5, 10-2,

TABLE 11

28 ITEMS DESCRIPTIVE OF THE THIRD FAMILY OF "POOREST" MECHANICS ($N=8$)

Item No.	Response	Item
10	Y	He works in a sloppy way.
12	Y	You wouldn't feel safe unless you checked behind him.
23	Y	He is no "whiz" in his line.
27	Y	Most guys with that much experience know a lot more than he does.
38	Y	He isn't a very careful worker.
11	N	When he does a job, you know it will be done right.
16	N	He is one of those ideal mechanics.
19	N	Many times he works overtime even when he doesn't have to do so.
25	N	He knows what any modification of a Tech Order is about.
34	N	He is a good man on any job.
44	N	He deserves a promotion.
47	N	You don't have to worry about telling him what to do all the time.
48	N	He continues on without taking many breaks.
49	N	He will straighten a guy out and explain things to him.
50	N	He seems just about the best I've seen as far as getting his work done.
65	N	He will do an overtime job instead of leaving it to one of the others.
66	N	He always has better ideas than most men.
68	N	He makes sure he does a good job.
70	N	He's the energetic type who has to have something to do.
73	N	His work is nearly 100% correct.
79	N	He knows all the systems on an airplane.
87	N	If he were an instructor, he could put it over pretty thoroughly.
91	N	He knows his stuff.
97	N	If you leave him to do a job, you can always be sure he will get the job done.
100	N	He reads new Tech Orders at his first opportunity.
103	N	He keeps working as long as there's a man left standing.
105	N	He can show you how to do the job right.
106	N	His ambition will pay off.

11-0, 12-1, 13-0, 14-5, 15-6, 16-4, 17-1, 18-2, 19-0, 20-0, 21-8, 22-1, 23-0. These comparisons between factors and types show that the descriptions of types cover a wide variety of information in terms of the factors involved. An additional advantage is that information is given directly about specified subjects. It is not necessary first to analyze factors and then assess each individual in terms of the factors.

The gains realized in terms of an agreement analysis are not obtained without a sacrifice. The types cover such a breadth of information that it is difficult to do justice to the description of a type other than by listing the items which are descriptive of each type. We have already listed the items of a class (including the first two orders) to illustrate one type of "best" mechanics. Another type of "best" mechanic is illustrated by the last order of "best" mechanics isolated. The items of this order are listed in Table 10, with those answered "Yes" listed first and those answered "No" following.

Normally, an order would have 16 individuals in a binary agreement analysis. The above order has only six because 48 of the 54 subjects in the sample were classified into the first three orders.

As an illustration of a type of "poorest" mechanics, the items descriptive of the third family (8 subjects) of poorest mechanics isolated are given in Table 11.

The items descriptive of the one additional order of "best" mechanics ($N = 16$), the one order of "poorest" mechanics ($N = 16$), and the three remaining families of "poorest" mechanics ($N = 8$, 6, and 8, respectively) are listed in Tables 12–16.

The descriptions of the fourth family (Table

TABLE 12

31 ITEMS DESCRIPTIVE OF THE THIRD ORDER OF "BEST" MECHANICS ($N=16$)

Item No.	Response	Item
2	Y	He wants to get in and do the job.
11	Y	When he does a job, you know it will be done right.
13	Y	He answers questions as best he can.
17	Y	He knows how to use tools.
31	Y	He always reports to work on time.
39	Y	You can always take his word for what he says he's done.
44	Y	He deserves a promotion.
47	Y	You don't have to worry about telling him what to do all the time.
57	Y	He sees decisions through to an end.
60	Y	He uses the right tools when he can get them.
68	Y	He makes sure he does a good job.
72	Y	He tries to find better ways of doing things.
84	Y	He stands up for what he believes in.
97	Y	If you leave him to do a job, you can always be sure he will get the job done.
101	Y	He usually remembers things which are explained to him.
105	Y	He can show you how to do the job right.
106	Y	His ambition will pay off.
107	Y	He is good at working on the plane.
109	Y	He likes being a mechanic.
118	Y	He gives good cooperation.
119	Y	He seems to take pride in his work.
10	N	He works in a sloppy way.
21	N	He is afraid to make a decision one way or another.
28	N	He just stands around until you're done before offering to help.
35	N	He's just careless.
53	N	You have to stand over him and show him how to do everything.
75	N	He doesn't seem to care what happens to him when he gets out of service.
95	N	No cooperation at all.
104	N	He isn't a credit to the Air Force.
113	N	Sometimes you can trust him and sometimes you can't.
120	N	He "goofs-off" all day long.

14) appear to be, in general, complimentary of the mechanics even though the mechanics were selected as "poorest" ones. This apparent inconsistency seems reasonable when we consider that the mechanics with whom we are concerned have been trained and selected for their jobs, and the terms "best" and "poorest" are relative and applied in this setting to small groups of mechanics. Each supervisor, who served as an informant in describing a mechanic, was requested to select either a "best" or a "poorest" mechanic and describe him. Each informant made his selection from those mechanics whom he had supervised in the last two years. Since the informants generally supervised not more than six or seven men in any one assignment, the group from which each informant made his selections was small. And each group, as already pointed out, contained only men who had been trained and selected as mechanics. It is not surprising then to find that eight of the 46 men chosen as "poorest" mechanics are described rather complimentarily. They probably are reasonably good mechanics. This conclusion from the experimental sample is consistent with the results from our cross-validational studies (Tables 5, 6, and 8) where at least 11 per cent of the "poorest" mechanics invariably classified as "best" ones in terms of our pattern analytic method.

However, there is a way in which the complimentary description of this family of "poorest" mechanics seems to differ from complimentary descriptions of "best" mechanics. The complimentary descriptions of "poorest" mechanics tend to avoid the most highly mechanic-centered descriptions. Instead, the compliments tend to be limited to the more general kinds of descriptions, such as: "He is a good man on any job"; "He

TABLE 13

38 Items Descriptive of the First Order (2 Families) of "Poorest" Mechanics ($N=16$)

Item No.	Response	Item
9	Y	He accepts responsibility only when he must.
10	Y	He works in a sloppy way.
22	Y	His superiors should not give him a higher AFSC.
23	Y	He is no "whiz" in his line.
27	Y	Most guys with that much experience know a lot more than he does.
28	Y	He just stands around until you're done before offering to help.
30	Y	He doesn't have any sense of responsibility.
38	Y	He isn't a very careful worker.
51	Y	He does things without first finding out what will happen.
74	Y	When he does get over to work, he doesn't do a thing.
115	Y	Instead of doing it, he says, "I'll think about it."
11	N	When he does a job, you know it will be done right.
16	N	He is one of these ideal mechanics.
17	N	He knows how to use tools.
25	N	He knows what any modification of a Tech Order is about.
34	N	He is a good man on any job.
44	N	He deserves a promotion.
47	N	You don't have to worry about telling him what to do all the time.
48	N	He continues on without taking many breaks.
49	N	He will straighten a guy out and explain things to him.
50	N	He seems just about the best I've seen as far as getting his work done.
57	N	He sees his decisions through to an end.
64	N	Everybody likes him.
65	N	He will do an overtime job instead of leaving it to one of the others.
66	N	He always has better ideas than most men.
68	N	He makes sure he does a good job.
72	N	He tries to find better ways of doing things.
73	N	His work is nearly 100% correct.
79	N	He knows all the systems on an airplane.
83	N	There are times when he keeps working even though everyone else takes a break.
90	N	Everyone enjoys working with him.
91	N	He knows his stuff.
97	N	If you leave him to do a job, you can always be sure he will get the job done.
100	N	He reads new Tech Orders at his first opportunity.
105	N	He can show you how to do the job right.
107	N	He is good at working on the plane.
118	N	He gives good cooperation.
119	N	He seems to take pride in his work.

TABLE 14

22 ITEMS DESCRIPTIVE OF THE FOURTH FAMILY OF "POOREST" MECHANICS ($N=8$)

Item No.	Response	Item
6	Y	If he were a crew chief, he would work right along with his men.
20	Y	He doesn't just sit back with his hands on his hips.
34	Y	He is a good man on any job.
39	Y	You can take his word for what he says he's done.
47	Y	You don't have to worry about telling him what to do all the time.
50	Y	He seems just about the best I've seen as far as getting his work done.
60	Y	He uses the right tools when he can get them.
72	Y	He tries to find better ways of doing things.
84	Y	He stands up for what he believes in.
85	Y	What he doesn't know he can find out for you one way or another.
90	Y	Everyone enjoys working with him.
97	Y	If you leave him to do a job, you can always be sure he will get the job done.
99	Y	He's just a normal guy.
35	N	He's just careless.
42	N	He has unpleasant characteristics.
58	N	We have had a couple of "run-ins."
75	N	He doesn't seem to care what happens to him when he gets out of service.
82	N	He is just a kid.
93	N	You have to explain every little step to him.
108	N	He doesn't care to mix with other people.
112	N	He is pretty unhappy about being in maintenance.
115	N	Instead of doing it, he says, "I'll think about it."

stands up for what he believes in"; "He is just a normal guy." The "best" mechanics on the other hand are often described in terms of items which pertain more specifically to their particular jobs as aircraft and engine mechanics, such as: "He knows how to use tools"; "He is good at working on the plane"; "He seems to take pride in his work"; "He likes being a mechanic."

Only six of the 43 items descriptive of the first class of "best" mechanics are included in the 20 items descriptive of the last order of "best" mechanics. In other words, we have evidence here of two quite distinct types of "best" mechanics.

Only 10 of the 22 items descriptive of the fourth family of "poorest" mechanics

TABLE 15

18 ITEMS DESCRIPTIVE OF THE FIFTH FAMILY OF "POOREST" MECHANICS ($N=8$)

Item No.	Response	Item
3	Y	He doesn't know his job.
22	Y	His superiors should not give him a higher AFSC.
23	Y	He is no "whiz" in his line.
27	Y	Most guys with that much experience know a lot more than he does.
31	Y	He always reports to work on time.
51	Y	He does things without first finding out what will happen.
80	Y	He has just an average working knowledge of the job.
84	Y	He stands up for what he believes in.
110	Y	It takes him quite a while to learn.
16	N	He is one of these ideal mechanics.
34	N	He is a good man on any job.
44	N	He deserves a promotion.
49	N	He will straighten a guy out and explain things to him.
50	N	He seems just about the best I've seen as far as getting his work done.
66	N	He always has better ideas than most men.
79	N	He knows all the systems on an airplane.
91	N	He knows his stuff.
100	N	He reads new Tech Orders at his first opportunity.

TABLE 16

7 ITEMS DESCRIPTIVE OF THE SIXTH FAMILY OF "POOREST" MECHANICS ($N=8$)

Item No.	Response	Item
9	Y	He accepts responsibility only when he must.
23	Y	He is no "whiz" in his line.
25	N	He knows what any modification of a Tech Order is about.
34	N	He is a good man on any job.
44	N	He deserves a promotion.
66	N	He always has better ideas than most men.
115	N	Instead of doing it, he says, "I'll think about it."

are included in the 43 items descriptive of the first class of "best" mechanics, and only two of the 22 items for the poorest family are included in the 20 items descriptive of the last order of "best" mechanics; *the numbers of items which are not common suggests that "best" and "poorest" mechanics differ in ways other than merely being opposite.*

Interassociations Between Factors and Types

In the above section on interpreting the types, comparisons were made with results from an unrotated, square-foot factor analysis of common data. In the present section, we wish to review the comparison for another purpose. We wish to call attention to interassociations between types and factors. The present evidence as to the exact nature of the associations is not maintained to be conclusive, and the data available are not the most crucial kind. The responses are descriptions by supervisors of mechanics, rather than known characteristics of mechanics. Consequently, whether the interrelationships derived from them reflect only the opinions of informants or are, in fact, characteristic of mechanics, is not known with certainty at this time. The factor analysis was unrotated, and by a square-root method rather than by a more exacting procedure. Likewise, the agreement analysis was by the binary method rather than the more exacting and complete procedure (6, 7).

Of the three types of "best" mechanics reported, the large class of them (32 subjects and 43 items) is heavily involved in the first factor in that all 10 of the items with the highest loadings on this factor are contained in the 43 items descriptive of this type. Each of the next two factors (in order of amount of variance accounted for) have none of their ten highest-loaded items in the 43 items descriptive of the large class of 32 subjects. This class had a disproportionate amount of its variance accounted for in the first factor, and consequently other types were involved in the second and third factors. In the fourth factor, the large class reappears together with the other two types of "best" mechanics. Eight of the ten highest-loaded items on this factor are included in the 43 items descriptive of the large class, and five of these plus two others of the ten highest-loaded items are among the 20 descriptive of the last order of "best" mechanics. The relative association of these types with other factors can be seen in the figures reported earlier which show the number of high-loaded items for each factor from each type. Similar results were reported for the third family of "poorest" mechanics (8 subjects and 28 items). They reveal that this type is heavily involved in factors 3 and 21, with 8 high-loaded items from each. The two "best" types reported had only one item with a high loading in either of these two factors. The high degree of association between factor 21 and this "poorest" type is even more striking when we consider that this factor accounts for only 0.8 per cent of the variance in the data analyzed, and the agreement analysis of "poorest" mechanics was done on only 46 of the 428 subjects on which the factor analysis was performed.

In this comparison of types with factors we have illustrated our points with one class of 32 subjects and one order of six subjects from "best" mechanics, making a total of 38 "best" mechanics and leaving one order of 16 "best" mechanics

unaccounted for. Analogously, we have used only one family of "poorest" mechanics, leaving four families of eight mechanics and one of six mechanics unaccounted for. Data analogous to that already reported are summarized for all of the above-mentioned types in Table 17. This table reports the 23 factors which were isolated in the unrotated square root solution, listed in order of amount of variance accounted for. All of these factors except the 10th, 14th, 20th, 22nd, and 23rd had 10 items with loadings above 0.100. These specified factors had only 9, 9, 6, 7, and 4 items respectively with loadings above 0.100. Table 17 is concerned with the 10 highest-loaded items for each factor except those which had fewer than 10 above loading of 0.100. For these, it is concerned only with those above 0.100. The table also lists types of "best" and "poorest" mechanics derived from the agreement analysis. These are the particular ones used in the reliability study, reported earlier. For each type, the table shows the number of high-loaded items on each factor. The table reveals, as already illustrated, that *types* are associated with *factors*.

Table 17 contains an additional lesson. It shows a way in which factor and agreement analyses can be used jointly in interpreting behavior. For this purpose, four or more highly-loaded items common to a factor and a type are taken to mean that a type is relatively high or low on a factor. For example, the four items listed under Factor 5 and opposite Type 1 mean that this "best" type is relatively high on this factor. Analogously, the four items under Factor 8 and opposite Type 4 mean that this "poorest" type is relatively low on this factor. The standings are all in the direction which would be expected from the names of the factors and the labels of "best" and "poorest" which are applied to the types, except for Type 6, the fourth family of "poorest" mechanics, which is complimentarily described as we have already pointed out.

Applying the procedure just outlined, we see that Type 1 subjects are responsible; they are not lazy or weak in character. They do not fail to use knowledge effectively, are industrious, remember well, are socially acceptable, are practical workmen and do not lack craftsmanship. Type 4 subjects, on the other hand, are low on responsibility and willingness to work; they are lazy and fail to use knowledge effectively; they are not industrious and do not remember well; they are not practical workmen or craftsmen, and they lack both intellectual capacity and job knowledge. This "poorest" type is defined

TABLE 17

HOW ITEMS DESCRIPTIVE OF EACH TYPE ARE DISTRIBUTED AMONG THE FACTORS IN TERMS OF THE HIGH LOADINGS[a]

Types	No. Items	No. Persons in Type	Factor Titles and Numbers: 1. Sense of Responsibility	2. Interest in Aircraft Maintenance	3. Willingness for Work	4. Laziness and Lack of Initiative	5. Weakness of Character	6. Failure to use Knowledge Effectively	7. Teaching Capacity	8. Industriousness	9. Memory	10. Self-Control	11. Inexperience	12. Social Acceptability	13. Lack of Morale	14. Practical Workmanship	15. Intellectual Capacity	16. Lack of Craftsmanship	17. Personal Pleasantness	18. Tendency to Mediocrity	19. Antisociability	20. Lack of Self-Control	21. Job Knowledge	22. Unlabeled	23. Unlabeled
"Best"																									
1—*1st* Class	43	32	10	0	0	8	4	5	0	5	6	0	1	5	1	7	1	5	2	2	2	0	1	1	2
2—*3rd* Order	31	16	8	1	1	6	2	4	0	6	4	1	0	2	3	2	0	2	0	1	0	0	0	2	3
3—*4th* Order	20	6	3	0	1	7	1	1	1	5	2	0	0	2	1	2	1	1	1	2	2	0	0	2	1
"Poorest"																									
4—*1st* Order	38	16	8	1	5	4	1	6	2	4	4	1	1	1	0	4	7	5	2	3	1	0	6	0	1
5—*3rd* Family	28	8	4	4	8	0	0	6	2	0	5	2	0	1	0	5	6	4	1	2	0	0	8	1	0
6—*4th* Family	22	8	3	0	1	0	0	0	0	1	1	0	1	3	2	2	1	0	1	2	4	1	1	2	1
7—*5th* Family	18	6	0	2	4	0	2	5	1	0	2	0	1	2	1	1	7	5	0	3	0	0	7	1	1
8—*6th* Family	7	8	0	0	1	0	0	0	1	0	2	0	0	0	0	0	3	0	1	2	1	0	7	0	0

[a] For example, of the 43 items which describe the 1st class of "best" mechanics, 10 of them are the same items which have the highest ten loadings on factor 1; none of the 43 is among the first 10 in terms of loadings on factor 2; the same is true for factor 3; eight of the 43 are among the first 10 for factor 4, etc. All of the factors except the 10th, 14th, 20th, 22nd, and 23rd had 10 items with loadings above 0.100. These latter factors had only 9, 9, 6, 7 and 4 items respectively with loadings above 0.100. In the case of these factors, the comparisons were limited to the numbers of items just specified. In all other factors, the ten items with the 10 highest loadings were used.

as opposite to the above "best" type in all but two factors (weakness of character and social acceptability) of the eight used to define the "best" one. In addition, the "poorest" type is defined as deficient in three factors which were not used in defining the "best" type (willingness to work, intellectual capacity, job-knowledge).

In an analogous fashion, the other types can be described concisely from Table 17. In describing these types, it should be remembered that the raw data are descriptions given by supervisors; the patterns of descriptions may exist only in the minds of the supervisors or both in their minds and in the behavior of mechanics. Consequently, the patterns are not known at this time to be characteristic of the behavior of mechanics. They are here reported only as characteristic of descriptions of mechanics by supervisors. Additional research is required to determine whether they would also be obtained from objective assessment of behavior.

We have shown that some items are internally consistent in both factor and pattern analytic analyses. However, there were nine items which were internally consistent for some of the types by agreement analysis but did not appear with substantial factor loadings on any of the factors. These items are as follows:

6 If he were a crew chief, he would work right along with his men.
13 He answers questions as best he can.
15 He will climb into one of the airplanes and sleep.
34 He is a good man on any job.
55 If there is something he likes to do, he does it faster than anyone else would.
57 He sees decisions through to an end.
67 He is very glad to help someone else.
73 His work is nearly 100% correct.
75 He doesn't seem to care what happens to him when he gets out of service.

The one thing that these items appear to have in common is that they are *extreme statements*. It seems that some items can be highly dependable for describing some one or more categories of subjects even though they are not generally dependable for describing all subjects in terms of any one factor.

We searched for items which had relatively high loadings but were not included in any of the types on which the reliability study was done. (The search was made at an intermediate level of classification.) Relatively high loadings were defined as sufficiently high so that an item was included in interpretation of a factor (either in the first ten items in terms of loadings for a factor or a loading above .100 in the case of those factors which did not have 10 items with loadings above this value). There were 30 items with relatively high loadings (as just defined) which did not appear in any one of the types on which the reliability study was done. In addition, there were 28 items with relatively high loadings which were not included in descriptions of "best" types and 25 other items with relatively high loadings which did not appear in descriptions of "poorest" types. These three categories of items plus the nine items already reported (which showed maximum relevancies for the types even though they had no relatively high loadings) make a total of 92 items on which there was considerable *difference* in the assessments of internal consistency by the two methods (agreement analysis and factor analysis).

Even though we grant that relative size of factor loadings on unrotated square-root factors, treated singly, is not a good estimate of internal consistency, the large discrepancies here reported show that there is a difference in the internal consistency of items as measured across all subjects (factor analysis) versus its assessment within selected categories of subjects (agreement analyis). In addition, these results show that many items differ in their validities for assessing factors and types. In short, these findings emphasize a new way in which reliability and validity are *relative* concepts; *they are relative to their assessment across all subjects versus their assessment within selected categories of subjects.*

The above results reveal the need for a more crucial comparison of results from factor and agreement analysis of common data, using the most refined technique of each method, together with data especially selected for the purpose of the comparison.

III. A Critique of the Method

It will be helpful now to react critically to the method just outlined and applied. The method is made computationally feasible by an arbitrary restriction; there is no reason (other than simplicity of classification) why the types at any one level should be composed of only two patterns from the next lower level. A more complicated version of agreement analysis avoids this arbitrary restriction (7). However, this latter method is laborious and it is felt that the present binary method is probably sufficiently exacting for our present state of knowledge.

Another problem of the method is that it sets no level of statistical significance which an agreement score must meet before a classification can be based on the score. The method circumscribes this problem by the following logic: It assumes types, and argues that if they exist for all patterns of response, then every pattern of responses must be classified and a solution is to give each pattern its best classification. This is a much less complicated solution than would be involved if the level of significance were required

to be computed for every classification of every pattern.

One could wonder whether or not "yes-no" answers are sufficiently dependable as a basis for classification. A reasonable reply to this kind of inquiry is to state that we do not have sufficient information of an appropriate kind on which to base an answer. Studies on the reliability of "yes-no" answers have been based on their dependability as assessed across all subjects of a sample. Agreement analysis recognizes the possibility of differential reliability of an answer; an answer may be highly reliable and dependable for some categories of subjects and not others. Agreement analysis enables us to determine whether or not "yes-no" answers have sufficient reliability of this kind to continue to justify the application of the method to them. Even if "yes-no" answers were found wanting, the method might still prove helpful if applied to categorized data, as obtained by dividing scores on several continuous variables into class intervals.

Agreement analysis does not allow us to assign every type a point in space in relation to every other type, and thus to give it a number which would reveal its location. Whether or not one wishes to do this depends on one's theory of the nature of types. If one wishes to assume that the same response in two different patterns has the same meaning, then it is reasonable to use the overlapping responses of patterns to assign types locations in space; this can be done in a method called linkage analysis (8). However, if one wishes to assume that the meaning of a response depends to a considerable extent on the pattern in which it occurs, then there would appear to be no basis for allocating the types to spatial locations on the basis of overlapping responses in their patterns.

Agreement analysis does not settle the differences in theoretical issues about types. It is, however, a method which should prove of assistance along with other methods in investigating some of the theories about types, and even in studying whether or not it seems worth while to assume types.

IV. Summary

This paper has applied an abbreviated version of a method of analysis, called agreement analysis, for the isolation and classification of types into a hierarchical system. An unusual feature of the method is that the terminal table on which interpretations are based contains every bit of information represented in the raw data; information is abstracted and generalized at successive levels, and the level most pertinent for a given purpose can be selected for further study. In addition, the method of analysis can handle all kinds of interrelations in data (linear, nonlinear, and disjunctive), and it also provides for giving various interpretations to any particular answer to an item, depending on the combination or pattern of other answers with which it occurs.

Illustrative applications of agreement analysis to descriptions of mechanics selected as "best" or "poorest" confirm the following hypotheses: The method yields both reasonably dependable and valid results. Descriptions of "best" mechanics can be differentiated from those of "poorest" ones on the basis of type membership. In addition, the results suggest the hypothesis that categories of people, such as "best" and "poorest" mechanics, can be most clearly differentiated in terms of many types, each type containing only a few highly similar subjects, rather than a few types containing many subjects. In terms of our data, there appear to be many types of "best" mechanics and many types of "poorest" mechanics—but no all-inclusive single type of "best" mechanic which differs from an all-inclusive type of "poorest" mechanic. Hypotheses of this kind can be further investigated by the method of agreement analysis which has been outlined here.

Results from our agreement analyses were compared with results from a factor analysis of common data. The comparison illustrated that the two methods classify data differently but not entirely independently; the factors and types which resulted are interassociated. Both methods yield results which appear to be meaningful and they can be used jointly in the interpretation of behavior.

However, some test items can have internally consistent responses for some categories of subjects in terms of an agreement analysis even though they are not sufficiently consistent across all subjects to yield any factor loadings of any consequence. These items appear to have value for selecting out rare subjects, such as a mechanic who is so expert that he is always 100 per cent correct; or, on the other hand, a poor mechanic who is so worthless that he would climb into an airplane and sleep.

Conversely, other items can be so internally consistent across all subjects that they have relatively high loadings and still not be retained as descriptive of any one of the predominant types at intermediate levels of classification. Consequently, the internal consistency of many items in terms of predominant types is quite different from their internal consistency in terms of factors. These issues on reliability of items under the two methods of analysis require further study by the most refined techniques of factor and agreement analyses with items especially chosen for the purpose.

REFERENCES

1. Etkin, W. *College biology*. New York: Thomas J. Crowell, 1951.
2. McNemar, Q. *Psychological statistics*. New York: Wiley, 1949.
3. McQuitty, L. L., Wrigley, C. F., & Gaier, E. L. An approach to isolating dimensions of job success. *J. appl. Psychol.*, 1954, **38**, 227–232.
4. McQuitty, L. L. Pattern analysis—A statistical method for the study of types. In W. E. Chalmers, M. K. Chandler, L. L. McQuitty, R. Stagner, D. E. Wray, and M. Derber, *Labor management relation in Illini City*. Vol. II, Champaign, Illinois: Institute of Labor and Industrial Relations, Univer. of Illinois, 1954.
5. McQuitty, L. L. Pattern analysis illustrated in classifying patients and normals. *Educ. psychol. Measmt*, 1954, **14**, 598-604.
6. McQuitty, L. L. A pattern analytic method derived from a theory of individual differences in psychological well-being. In S. B. Sells, Chairman, *Symposium on pattern analysis*. Randolph Field, Texas; Air University, USAF School of Aviation Medicine, 1955.
7. McQuitty, L. L. Agreement analysis: Classifying persons by predominant patterns of responses. *Brit. J. Psychol.*, 1956, **9**, 5–16.
8. McQuitty, L. L. Elementary linkage analysis for isolating orthogonal and oblique types and typal relevances. *Educ. psychol. Measmt*, in press.
9. Meehl, P. E. Configural scoring. *J. consult. Psychol.*, 1950, **14**, 165–171.
10. Zubin, J.. A technique for measuring like mindedness. *J. abnorm. soc. Psychol.*, 1938, 33, 508–516.

(Accepted for publication March 12, 1957)

GEORGE BANTA COMPANY, INC., MENASHA, WISCONSIN